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(54) Air bag valve assembly.

(57) An air bag valve assembly (28) for installation in an opening (30) in the fabric wall of an air bag (18) includes first and second gas permeable housing panels (32-36) of flexible sheet material which overlie one another and form a housing envelope in which a valve flap panel (31) of flexible sheet material is supported. A tether (50) is attached to the valve flap panel (31) to move the valve flap panel (31) along the housing panels (32-36) when the tether (50) is actuated. The valve assembly (28) may be normally closed by using a gas impermeable material for the valve flap panel (31).
Alternatively, the valve assembly (28) may be normally open and closable on actuation of the tether (50) to block the flow of gas. The housing panels (32-36) may be of a gas impermeable fabric having holes cut therein or of an open weave mesh construction.

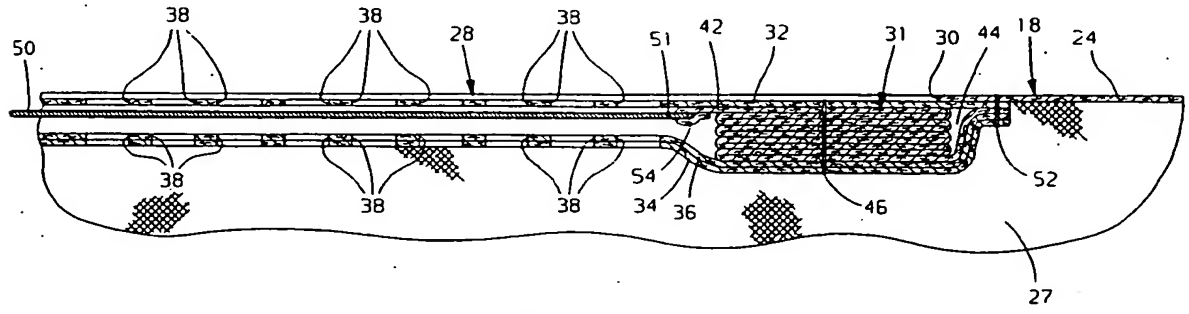

FIG. 3

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The present invention relates to an air bag valve assembly installable in a wall of an air bag to control the inflation of the air bag.

It is well known to provide an inflatable air bag for restraining a vehicle occupant. The air bag assembly includes a folded bag which is connected to a source of inflation gas. Release of the inflation gas into the air bag causes the bag to expand rapidly so that a face wall of the air bag is displaced towards contact with the occupant. It is well known to provide one or more vent openings in the walls of the air bag to vent inflation gas from the interior of the air bag into the passenger compartment. These air bag vents are commonly provided in a base wall portion of the air bag to direct the vented gas away from the occupant. In addition, it is well known to employ various flow control devices to control the flow of inflation gas through the vent opening.

The present invention seeks to provide a new and improved air bag valve assembly for an air bag.

According to an aspect of the present invention, there is provided an air bag valve assembly as specified in claim 1.

A preferred embodiment of air bag valve assembly includes first and second valve housing panels or strips of flexible sheet material which overlie one another and are gas permeable. The edge portions of the housing panels are stitched together to form a housing envelope in which a valve flap panel of flexible sheet material is supported. A tether is attached to the valve flap panel to move the valve flap panel across the gas permeable first and second panels when the tether is actuated. The valve assembly may be normally closed by using a gas impermeable material for the valve flap panel. Alternatively, the valve assembly may be normally open and then the actuation of the tether pulls a gas impermeable valve flap panel across the gas permeable first and second panels to block the flow of gas. The housing panels may be of a gas impermeable fabric having holes cut therein, or the panels may be an open weave mesh construction to pass gas therethrough.

It is possible to provide a valve assembly for an air bag which can be operated between positions in response to the degree of displacement of the air bag from the stored position to the inflated position.

The air bag control valve assembly can be readily sewn into an opening provided in the air bag wall.

There is preferably provided a valve assembly formed of a flexible sheet valve flap interposed between inner and outer housing strips of gas permeable flexible sheet material so that the housing strips may be sewn into an opening in the air bag fabric and which guidably mount the valve flap for movement with respect to the gas permeable housing strips selectively to open and close the gas flow.

The movable valve flap is preferably movable in response to the degree of displacement of the air bag to the fully inflated position.

According to another aspect of the present invention, there is provided an air bag comprising one or more valve assemblies.

An embodiment of the present invention is described below, by way of illustration only, with reference to the accompanying drawings, in which:

Figure 1 is a side elevation view of an occupant compartment showing an air bag incorporating an embodiment of valve assembly mounted on a steering wheel;

Figure 2 is an enlarged fragmentary view showing the valve assembly of Figure 1;

Figure 3 is a sectional view taken in the direction of arrows 3-3 of Figure 2 and showing further details of construction of the valve assembly of Figure 1, including gas permeable housing panels, a valve flap, and a tether for closing the valve flap across valve openings of housing panels;

Figure 4a is a schematic view showing an air bag deployment in which the air bag has reached only a limited degree of displacement to the inflated position so that the vent operating tethers remain slackened and the vent openings remain open to vent inflation gas to the passenger compartment;

Figure 4b is a view similar to Figure 4a showing the air bag inflated to a greater degree of air bag displacement so that the tethers are tensioned to begin closing the valve flaps over the vent openings;

Figure 4c is a view similar to Figures 4a and 4b showing a fully displaced air bag in which the tethers are tensioned and have pulled the valve flaps fully over the vent openings;

Figure 5 is a view similar to Figure 3 showing a second embodiment of valve assembly in a normally closed position;

Figure 6 shows the valve assembly of Figure 5 in an opened position; and

Figure 7 shows another embodiment of valve assembly in a normally closed position; and

Figure 8 shows another embodiment of valve assembly in a normally open position.

Figure 1 shows a motor vehicle 10 having a passenger compartment 12 in which driver 14 is seated in seat 16. An air bag 18 of flexible fabric material is mounted on the steering column 20 and receives inflation gas from an inflator 22. The air bag 18 includes a base wall portion 24 attached to the steering wheel and a face panel 26 for contact

which registers with the openings 90 and a gas permeable portion 96 which is stacked and retained within storage pocket 100 by a stitch 98. The gas permeable portion 96 is formed from a loose weave fabric which provides an open mesh screen. The tether wire 102 is attached to the gas impermeable portion 94 by a looped portion 104 thereof and, when tensioned, pulls the gas impermeable portion 94 away from the openings 90 as shown in Figure 6 so that the gas permeable portion 96 registers with the openings 92 to permit flow of gas through the air bag wall 88.

Figure 7 shows another embodiment in which a normally closed valve is provided. The valve assembly 108 of this embodiment includes an outer housing strip 110 and a single inner housing strip 112 which are formed from a loose weave open mesh screen fabric or plastics material which permit the flow of gas therethrough. A valve flap 114 of gas impermeable material is disposed between the outer housing strip 110 and inner housing strip 112 normally to block the flow of gas through the valve assembly 108. However, when the tether wire 115 is tensioned, the movable valve flap 114 is released by a bead of adhesive 118 so that the movable flap 114 may be pulled away from its position of Figure 7 covering the gas permeable housing strips 110 and 112. It will be understood that the left hand end of the housing strips 110 and 112, as seen in Figure 7, will separate as necessary to permit the movable flap 112 to exit from the valve housing.

Figure 8 shows another embodiment in which a valve assembly 120 is provided and shown in a normally open position. The valve assembly 120 includes an outer housing strip 122 and first and second inner housing strips 124 and 126 having gas flow openings 128 punched or cut therein to permit the flow of gas therethrough. A valve flap 132 of gas impermeable material is disposed between the outer housing strip 122 and the inner housing strip 124 and has a normal position as shown in Figure 8, in which the gas flow openings 128 remain open. The valve flap 132 has a tail end 134 which extends through a slot 136 in the inner housing strips 124 and 126. When the tether wire 140 attached to the valve flap 132 is pulled, the valve flap 114 is pulled across the flow openings 128 to block gas flow through the openings, the tail end 134 being pulled through the slot 136 so that the movable flap 132 is progressively fed into the valve housing so as to move across the flow openings 128 as the tether wire 140 is pulled.

It will be understood that Figures 3, 5, 6, 7, and 8 show the housing strips separated from one another for purposes of clarity, it being recognized that in an actual air bag construction these walls will be juxtaposed closely with one another, particularly when the air bag assembly is folded for storage in the pre-deployment condition.

Furthermore, it will be understood that although the air bag shown herein is a driver side air bag, it may also be used as a passenger air bag.

The tether 50, 66, 102, 115, 140 may be anchored on the air bag or on the inflator so that relative movement between the wall of the air bag which carries the valve assembly and the anchored end of the tether will operate the valve assembly.

Although the Figures show the tether as a wire, it may be a nylon fabric strip and may be of continuous one-piece construction with the valve flap.

The valve assembly may be provided in either a normally opened or normally closed condition and the movable valve member may be completely impermeable to gas flow to provide complete cut off of gas flow through the valve assembly, or the valve flap may be somewhat gas permeable to permit any desired level of controlled flow through the valve flap even when the valve flap assembly is in the closed position.

The valve assembly includes a housing formed by gas permeable members and a valve flap which slides between the housing panels between positions opening and closing the flow through the gas permeable housing panels. The housing panels may be sewn or otherwise suitably attached to the air bag wall to register with an opening provided by a slot or apertures cut in the air bag wall. The movable flap can be releasably anchored to the housing strips by a stitch, adhesive, or other suitable means, or the flap may be restrained in the normal position merely by the frictional contact between the valve elements. The gas permeable material may be either a tight knit fabric having holes cut therein, or a loosely weaved fabric leaving air flow passages between the threads thereof.

Other ways of controlling the operation of the above-described flap valves are disclosed in our co-pending European patent application no. (RJ/3867) filed the same day as this application, the contents of which are incorporated herein by reference.

The disclosures in United States patent application no. 981,336, from which this application claims priority, and in the abstract accompanying this application are incorporated herein by reference.

Claims

1. An air bag valve assembly for installation in an opening in a wall of an air bag, comprising first and second gas permeable panels (32-36) of flexible sheet material overlying one another and including edge portions joined together to

with the driver 14, and which cooperate to form a chamber 27 within the air bag 18. Figure 1 also shows that the air bag 18 has a vent 28 provided in the base wall portion 24, it being understood that another vent 29 is located on the opposite side of the air bag 18. Each vent 28,29 has an associated closure valve.

Figures 2 and 3 show the construction of the vent 28 and its closure valve assembly. The air bag base wall portion 24 has an elongate slot 30 cut therein. A vent valve assembly 31 is formed from a valve housing including an outer panel or strip 32 and two inner panels or strips 34 and 36 which overlie one another and have a plurality of small vent holes 38 cut therein. A valve flap 42 is interposed within the housing envelope formed between the outer strip 32 and the inner strips 34 and 36 and folded in a stack of accordion pleats stored within a storage pocket 44 as best shown in Figure 3. The vent flap 42 may be retained in this stacked condition by a stitch 46 which extends through the outer strip 32, the stacked valve flap 42 and the inner strips 34 and 36.

As seen in Figures 2 and 3, the outer dimensions of the vent valve assembly 31 are wider and longer than the dimension of the slot 30 in the air bag 18 so that the vent valve assembly 31 may be sewn to the air bag 18 by a row of stitches 52 which encircle the slot 30.

A tether wire 50 has an end 51 which is held in a loop 54 sewn or glued at the end of the valve flap 42. As seen in Figure 2, the tether 50 passes through the row of stitches 52 so that the tether wire 50 is guidably supported in the air bag 18.

Referring to Figures 4a, 4b, and 4c, it is seen that the tether wire 50 has an end 58 which is suitably attached to the face panel 26 at a fabric loop 62 sewn to the face panel 26 on the inside surface thereof. Figure 4a also shows that the vent 29 located on the opposite side of the air bag 18 from the vent 28 has a vent valve assembly 64 associated therewith which is identical to the vent valve assembly 31. The vent valve assembly 64 is operated by a tether wire 66 which is attached to the inside of the face panel 26 by a loop of fabric 68.

Figures 4a, 4b, and 4c schematically demonstrate three different air bag deployment conditions, it being understood that the air bag 18 is normally folded upon itself and concealed within a plastics container on the steering wheel until the introduction of inflation gas from the inflator 22 causes the air bag to burst from the container and begin displacement of the face panel 26 towards the occupant 14.

Figure 4a shows a deployment condition in which the displacement of the face panel 26 is limited by the position of the occupant so that the tether wires 50 and 66 remain in a slackened condition, which permit the vents 28 and 29 to remain in the open condition shown in Figures 2 and 3.

Figure 4b shows a different deployment condition in which the face panel 26 has obtained a further degree of displacement in which tether wires 50 and 66 and have become tensioned and the tether wire 50 has pulled the valve-flap 42 to sever the flap stitch 46 and permit the valve flap 42 to move partway across the vent openings 38 so that the aggregate size of the vent openings 38 is partially reduced.

Figure 4c shows a deployment in which the face panel 26 is fully displaced upon full inflation of the air bag 18 so that the tether 50 has completely unfolded the flap 42 to close off completely the vent openings 38.

It will be appreciated that the use of the air bag vent arrangement disclosed herein permits tuning of the air bag system to a wide range of desired performance characteristics. For example, the size, number and spacing of the vent openings 38 may be varied. In addition, the material of the valve flap 42 can be chosen to be either a gas permeable or impermeable material.

It is also known that the displacement of the air bag 18 to the deployed condition routinely occurs at such speed that the displacement of the bag overtakes the pressure buildup provided by the inflator so that the gas pressure inside the bag is less than the ambient air pressure in the passenger compartment. Thus, although the vents are open during displacement, little or no gas may be actually vented from the bag. Thus, a full displacement to the position of Figure 4c is accomplished with little or no venting, while the partial displacement to the position of Figure 4a will leave the vent open during pressure buildup so that gas will be vented out of the air bag 18.

It will also be understood that the length of the tethers 50 and 66 may be selected of a length to limit the overall displacement of the air bag 18 so that these valve operating tethers will also function as travel limiting tethers for the air bag face wall 26.

Referring to Figures 5 and 6 an alternative embodiment of the valve assembly 76 includes a housing formed by an outer strip 78 and a pair of inner strips 80 and 82 stitched together around the edges 84 thereof and overlying a slot 86 provided in the wall 88 of the air bag. The outer wall 78 and the inner walls 80 and 82 have a plurality of openings 90 punched or cut therein to provide a gas permeable structure to enable the passage of gas through the housing strips 78, 80 and 82. A valve flap 92 is disposed between the housing strips 78 and 80 and includes a gas impermeable portion 94

form a housing envelope; a valve flap panel (42) of flexible sheet material interposed between the first and second panels and supported for movement along the first and second panels; and a tether (50) including a first end operably associated with the valve flap panel and a second end operable to actuate the tether to move the valve flap along the gas permeable first and second panels.

2. An air bag valve assembly according to claim 1, wherein the first and second panels are formed from a fabric material having holes (38) formed therein.

3. An air bag valve assembly according to claim 1, wherein the first and second panels are formed from an open weave mesh.

4. An air bag valve assembly according to claim 1, 2 or 3, wherein the valve flap panel includes a gas impermeable portion (94) normally supported across the first and second panels and movable away therefrom by the tether to permit gas flow through the first and second gas permeable panels.

5. An air bag valve assembly according to any preceding claim wherein the valve flap panel includes a gas permeable portion (96) and a gas impermeable portion (92), with one portion normally disposed across the first and second panels of the housing envelope and the other portion stored for subsequent movement across the first and second panels when the tether is operated.

6. An air bag valve assembly according to any preceding claim, wherein the valve flap panel includes a stored portion (31,96,134) movable along the first and second panels when the tether is operated.

7. An air bag valve assembly according to claim 6, wherein the stored portion (31,96) is stacked in a folded condition and stored in a storage pocket (44,100) of the housing envelope.

8. An air bag valve assembly according to claim 7, including a releasable retainer (46,98) acting between the valve flap panel and the housing envelope to retain the valve flap panel in the stored position and to release the valve flap panel when the tether is operated.

9. An air bag valve assembly according to claim 6, wherein the stored portion (134) extends through a slot (136) provided in the housing envelope and is storable inside an air bag.

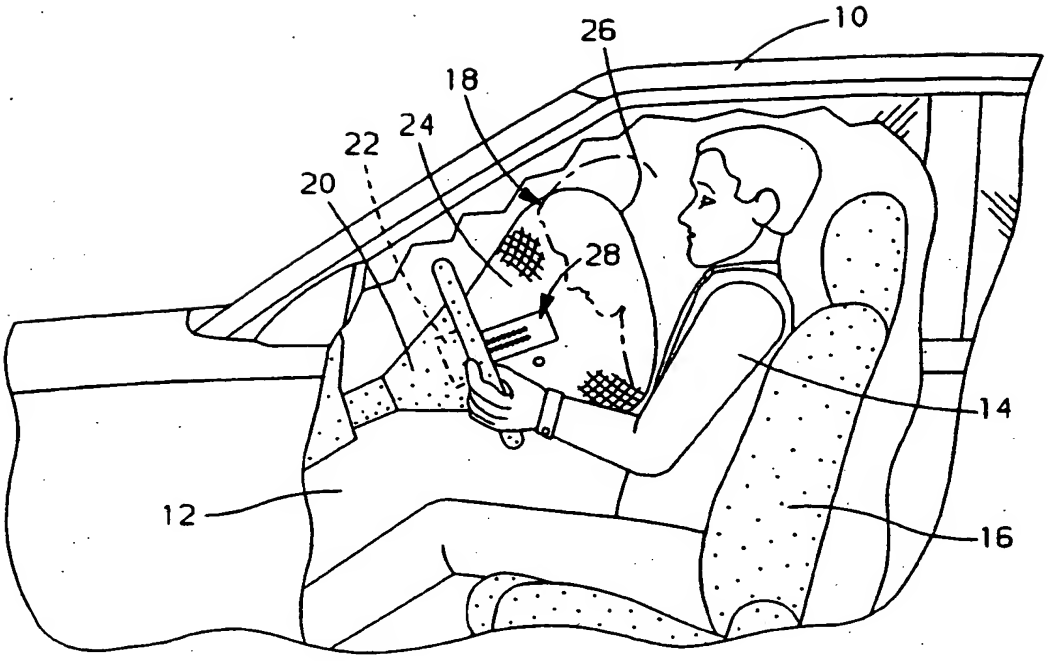
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FIG. 1

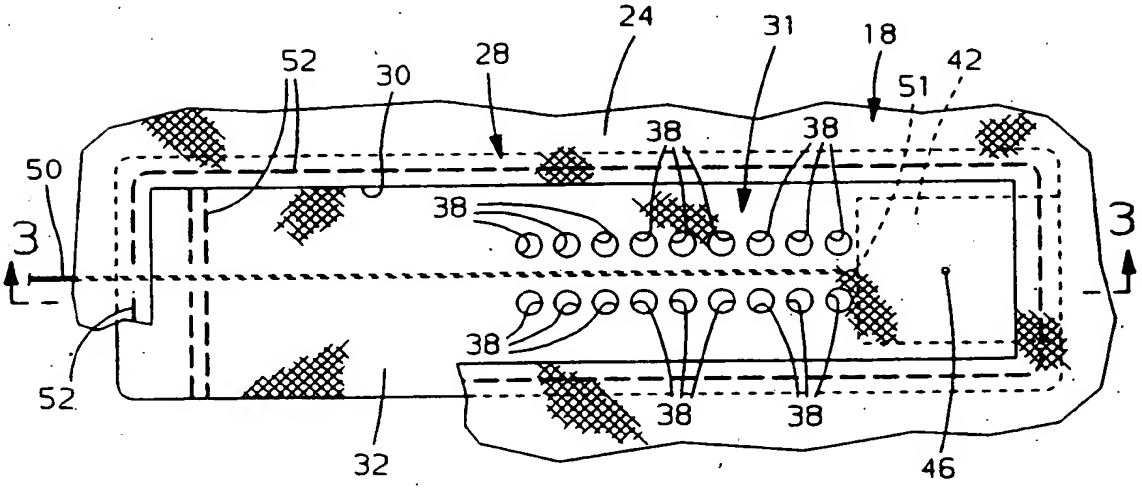
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FIG. 2

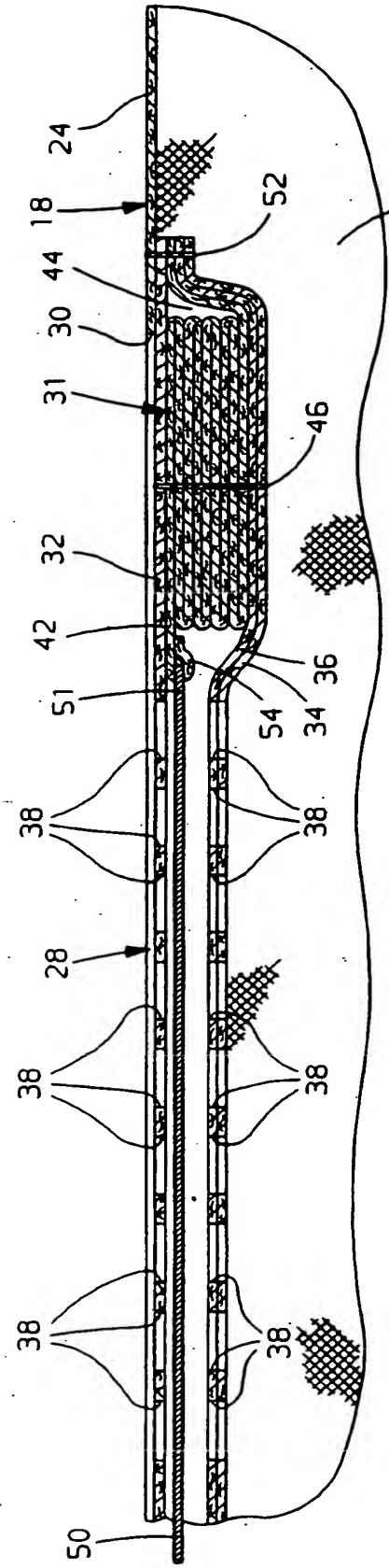

FIG. 3

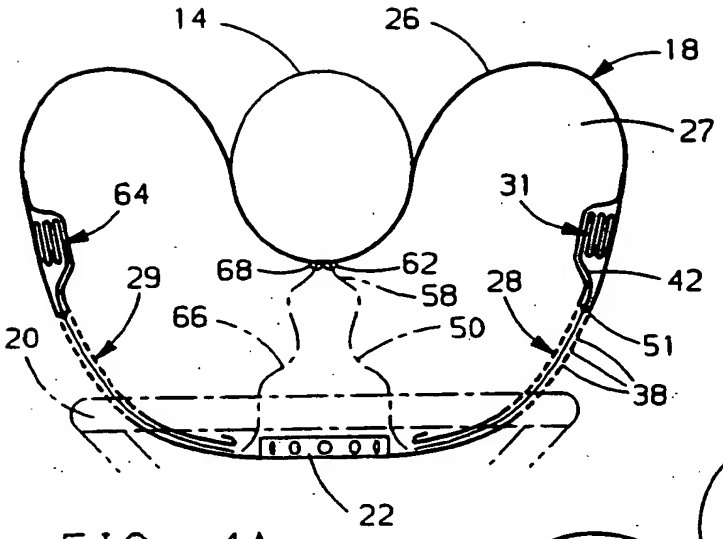

FIG. 4A

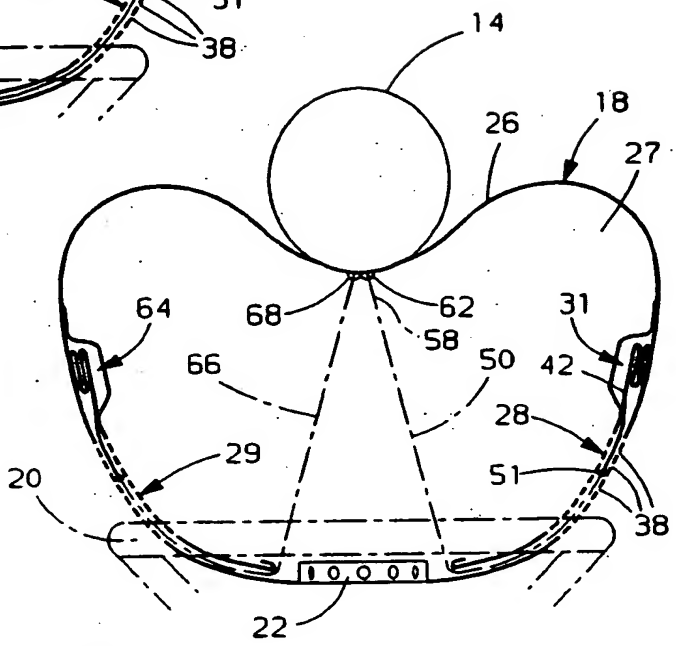

FIG. 4B

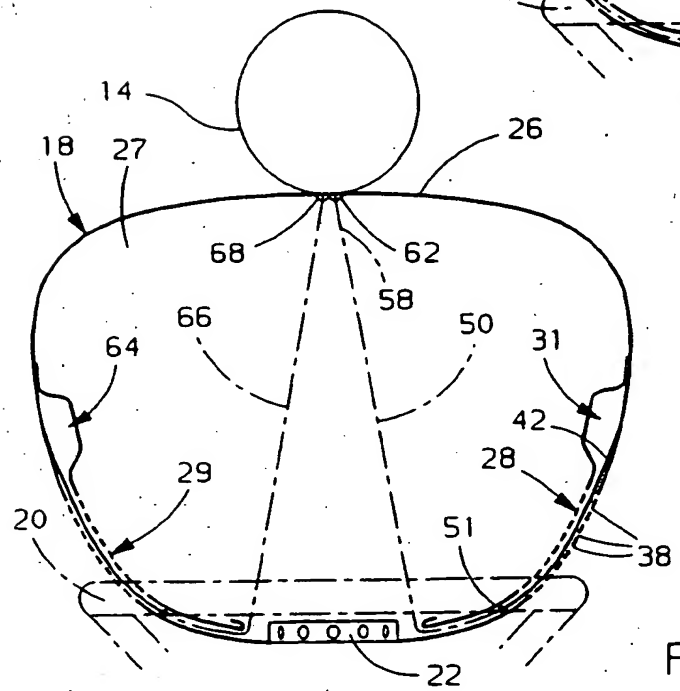

FIG. 4C

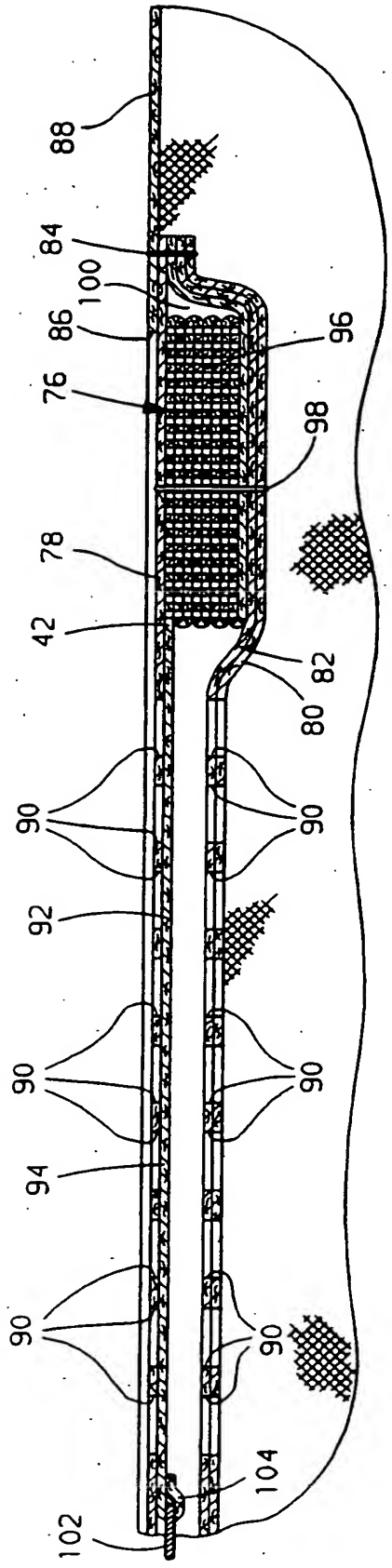
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FIG. 5

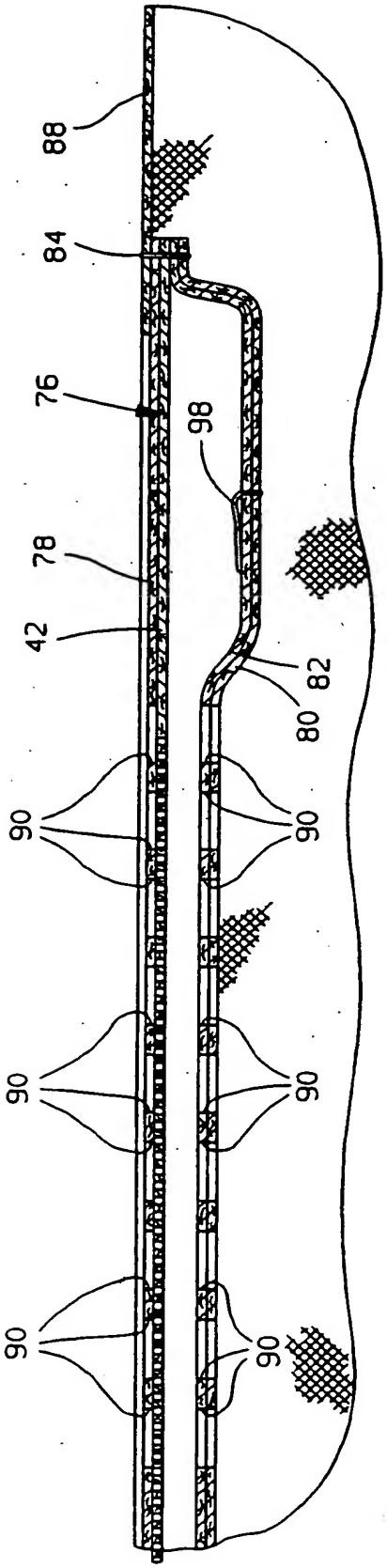
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FIG. 6

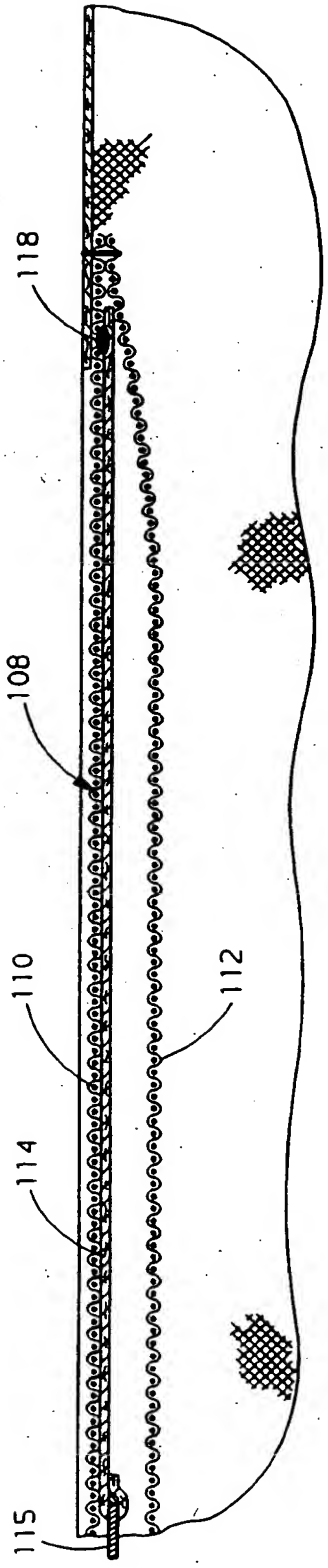
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FIG. 7

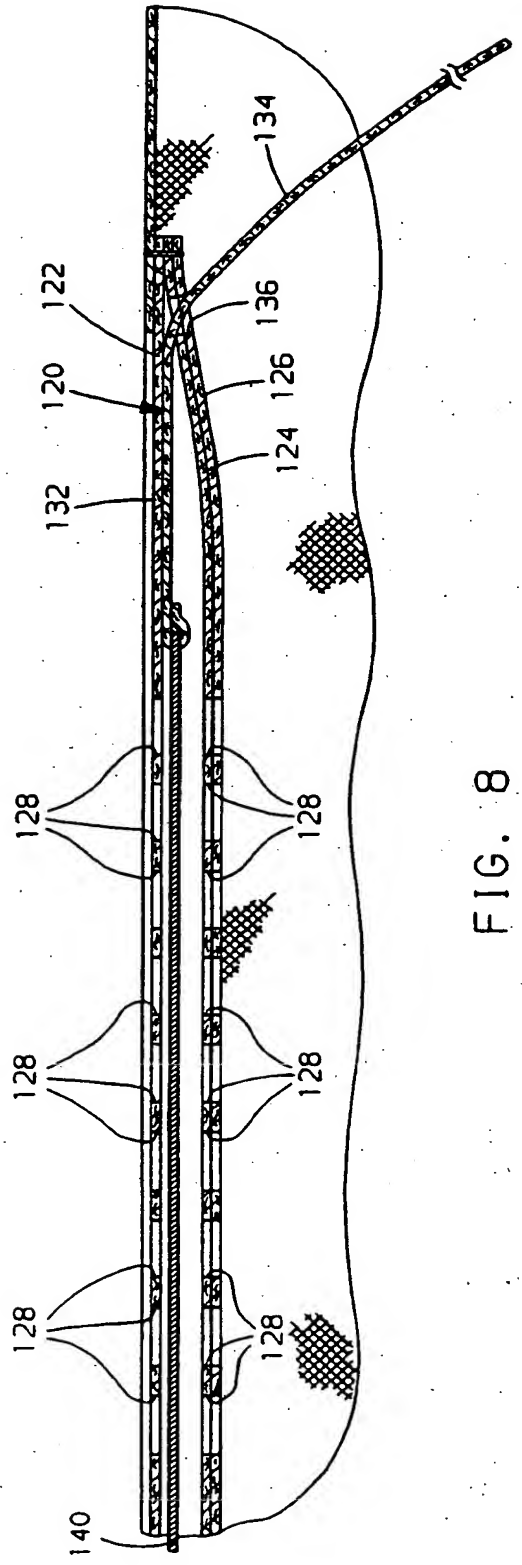
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FIG. 8

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 93 20 3176

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
A	DE-A-21 16 347 (DAIMLER-BENZ AG) * claims 1,4,7,8,13-17; figures 5-8 *	1,2	B60R21/16
A	DE-A-19 62 890 (EATON YALE & TOWNE, INC.) * claims; figures *	1,2	
A	DE-A-36 18 060 (BAYERISCHE MOTOREN WERKE AG) * the whole document *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.5)

B60R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	22 February 1994	Dubois, B

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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